Discussion Paper
Boreal Forest Monitoring Workshop,
Whitehorse, Yukon
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The purpose of this paper is to summarize the presentations and discussion at the above-mentioned workshop. The paper is also meant to be the first step to defining and resolving some of the issues that were raised at the meeting as they relate to "getting going" with a national boreal forest monitoring plan. To meet that intent, a proposed conclusion/action statement is included under discussion items.

Meeting Overview

A one-day workshop was organized in Whitehorse on October 10, 2002 to discuss boreal forest songbird monitoring. The organizers were Craig Machtans, Connie Downes and Wendy Easton. Presentations were given in the morning regarding current monitoring initiatives across boreal North America and a discussion session was held in the afternoon. This paper primarily summarizes the afternoon discussion. The meeting agenda is attached as Appendix 1. No participant list was made. A text summary of the majority of presentations is also attached.

Substantive Issues

Need

There appeared to be unanimous agreement on the need for a national program to monitor boreal forest songbirds. Such a program will require a combination of new and current techniques and approaches since current monitoring programs are not adequately addressing information needs about the boreal forest.

Rationale

In considering a national program, several items came up for discussion:

1. There was a clear indication that CWS should, and must, lead the coordination of a national boreal forest monitoring program.
2. There was a clear indication that CWS needs to elucidate a national vision for such a program.
3. The existence of other programs such as the Alberta Biodiversity Monitoring Plan, BBS, and migration monitoring spurred some discussion regarding how a new CWS-led national program could integrate with these current initiatives.

4. To rationalize the need for a new program we first need to quantitatively describe the potential abilities and limitations of the two main monitoring programs (BBS and migration monitoring) that currently provide some data on boreal bird populations.

Proposed Conclusion: CWS should lead an initiative to develop a national boreal forest monitoring program. New methods are required, in concert with proven approaches, although the role of current monitoring programs as part of this new plan will be quantitatively examined and used to the extent possible.

Any strategies and proposals produced for the national boreal forest monitoring plan will stress the cross-links with current programs and may even seek to strengthen them with directed resources that are specific to the goal of the national plan

Program Objectives

The following items were considered key objectives of a national monitoring plan. The objectives are NOT in any particular order.

1. Solidify bird-habitat relationships, including on a national scale.
2. Acquire population trend information.
3. Define bird distribution and relative abundance accurately.
4. Provide information relevant to conservation issues: climate change, development/land use trends, etc.
5. Productivity information for certain areas may also be necessary for adequately meeting monitoring goals.

Proposed Conclusion: There are a small number of key objectives that are interrelated. **The objectives need to be articulated clearly and prioritized to ensure that early efforts address areas of greatest weakness/need.**

Preliminary/Pilot Work Needed

Some preliminary analyses are necessary to substantiate the necessity of the national program, including: (elaborating on point #4 under Rationale)

- Analysis of the migration monitoring data: What species does it monitor? How much is it telling us about these species? Would more stations help answer the basic questions? If so, how many more, and where?
- Analysis of BBS data/potential: What analytical impact would running all boreal forest routes have on BBS analysis power? Given the available road network, how many more routes could be put into the boreal forest? What effect would running these additional routes have? Are there areas in the boreal forest where the road network would allow effect monitoring by BBS routes (e.g. southern Yukon)?
- Power analysis for a system of point counts distributed across the boreal forest.

Program design/execution

This section summarizes some of the technical issues of sampling design.

It was agreed that a quantitative approach to designing the sampling program is necessary (and is already used in other large programs). It is worthwhile to note that substantial, directly relevant analyses have already been published, and are available as resources. For examples, visit the links at the end of this document.

- It was agreed that, unlike southern Canada, the success of a boreal forest program could ***not*** depend on volunteers.
- A sampling scheme that attempts to get population trend data should consider precision vs. cost as a design consideration. The 2-3% change per year cumulative over 20-30yrs is an accepted PIF standard and is the target used by the Alberta Forest Biodiversity Program.
    - Proposed Conclusion: Adopt the PIF standard for trend detection as the baseline for population monitoring in the boreal forest.
- It was agreed that each sampling location needed multiple sample points. This helps offset some shortcomings of visiting sites once and of having relatively short counts. It also makes logistical sense to place one sampling team in one location per day.
    - Proposed Conclusion: A sampling strategy with sub-points is necessary. The final design will be determined after rigorous evaluation of possibilities.
- Use of transects vs. point counts. It was agreed that transects are an accepted method for winter bird surveys, but there was accord that point counts should be the standard method for songbirds in the breeding season.
    - Duration of point counts was discussed, debating 5 min vs 10 min. There are many good reasons to choose either, but much of the available data available uses the 10-minute standard. Additionally, analyses from Yukon showed that only 75% of observations would be achieved in 5 min vs 10 min.
    - Proposed Conclusion: Adopt a 10- min point count standard for surveys of migratory species. Further discussion is required on how to subdivide the 10 minutes e.g. 0-5, 5-10 and perhaps 0-3 minutes (for comparability with BBS).
    - There was additional discussion on using a transect-like approach when moving between different sampling locations. There was evidence from several sources (e.g., Kluane) that collecting data in this manner is quite valuable. The time spent searching for birds needs to be standardized.This transect technique could address some issues for sampling rare species or other species not usually captured by point count surveys.
- Distribution of sample points was discussed. There are two possibilities:
- 1) Extensive coverage (random or systematic) is the preferred option. Covering all areas systematically negates the design trade-offs and (literally) endless debate about how to choose priority sample areas relative to current issues. Post-hoc stratification to regional, ecological, or other strata would be possible, within statistical constraints. This approach gives maximum data to answer all potential questions. However, it is the most expensive and difficult approach to implement. The Alberta program has technical information on this approach. Control areas will be necessary, since it is unlikely that extensive coverage will occur at program inception.
- 2) Stratification by "some" ecological/political unit is the second option. Stratification will constrain analyses and MUST be accompanied by suitable control/benchmark areas. Although less expensive, a stratified program may ultimately be unable to answer future questions on population trends in the boreal forest at the national scale because it risks

limiting potential conclusions to the questions posed during the initial study design. Data may become confounded during circumstances that may only arise in the future, after the program is well underway.

  - Proposed Conclusion: A systematic or random coverage of the entire sample area by point counts is the best choice. If a less extensive approach is adopted, either as a pilot or as the final program, then selection and use of suitable control areas will be a critical design component. Study design will be very difficult, given the range of discussions and competing values with a limited coverage.

- How often should survey locations be re-visited? Discussion points included:
  - biannual surveys are effective at detecting population trends with nearly the same power as annual surveys.
  - However, many species exhibit a biannual variation (e.g. redpolls), and many questions require continuous change data to adequately determine variation.
  - Proposed Conclusion: At least some of the sample locations throughout the program should be surveyed annually. The actual number will have to be determined through quantitative analyses.
- Other sampling issues that were mentioned and will need thought:
  - Resident species in addition to migratory species
  - Rare or otherwise difficult to monitor species
  - Priority species
  - MAPS sites are not randomly chosen, but purposefully placed in landscapes where questions regarding survivorship and productivity need answering.
  - Bias and style of point counts: unlimited, radius bands or VCP. There was much discussion on point count methodology and the pros and cons of using a system to estimate biases. Some major issues raised include:
    - Training costs increase with the need for "better" distance estimates
    - Few, if any, leading Canadian researchers believe that aural distance detection is accurate enough to justify VCP/DISTANCE analyses (not even considering how point counts violate the basic assumptions of those sampling schemes).
    - The design may incorporate other bias-reducing methods (e.g., double-observer methods)
  - Use of omni-directional microphones (aka Hobson) was discussed:
    - Pros
      - Little staff training and expertise needed.
      - Permanent, archived copy of point count always available. This allows reinterpretation of species identification, number of individuals, observation/detection rates and more.
    - Cons
      - No distance estimates obtained
      - No visual detections or confirmations possible

Funding

Several different ideas came up with regard to funding a national-scale program. Among them were:

- Use of a trust approach such as the Alberta Biodiversity Monitoring Program;

- Use of the partnering approach (obviously);
- Follow the NAWMP model
- Memorandum to Cabinet through Environment Canada for substantial, on-going dollars;
- Potential dollars through NABCI
- Emphasizing the value of such a program to climate change detection (for $$ sources);
- Potential use of environmental assessment dollars for partial funding
- Nobody mentioned begging Bill Gates to save boreal birds from the goodness of his heart.

Proposed Conclusion: There are definitely funding opportunities for a national monitoring program. Dollars will have to come from several sources that have <u>long-term</u> commitment to funding.

Proposed Action: Members of the PIF technical committee begin discussing the general notion of the monitoring plan and ballpark costs with their managers to get the funding issue on management's radar screen. It will cost millions of dollars per year.

Strategic approach to program

- Several participants indicated that a major selling point to a national boreal forest monitoring program would be the inclusion of existing programs (e.g. migration monitoring, BBS, etc.). The key aspect was to ensure we were maximizing value from the existing programs in addition to adding new methods to fill in the data gaps. For instance, migration monitoring may have significant value in an integrated program, but it is not currently (and may never) achieve the primary goals of this proposed national plan.
- Products: The approach to packaging the national monitoring plan was discussed. A proposed solution, summarized by Mike Norton follows:
- Two documents are needed. The first is the "strategy" and the second is the "design" or "plan". The strategy would be a relatively short document intended, for now, as an internal CWS document that lays out the vision, scope, mandate, etc of a boreal bird monitoring program. This first document would also identify CWS's role in the developing program, indicate the costs (as order of magnitude at least) and suggest how these costs could be met through various partnership or cost-sharing arrangements. The second, more technical, document would concentrate on design and other technical details. This second document would be prepared in conjunction/consultation with other (including non-CWS) relevant partners/experts.
    - Proposed Conclusion: There seemed to be consensus on the need and usefulness of a two-document approach. The second technical document should be a collaborative effort from inside and outside CWS and should reflect a national view.
- Some ideas that were discussed to help sell the program:
    - Using birds as one of Canada's contributions to the world. (The idea that Canada is a major "exporter" of migratory birds)
    - Identify and consider our clients and their needs.
    - Provide two or three cost scenarios with a description of the level of biological information collected for each price.

Key Resources

It is critical to note that much of the necessary background research on study designs, costing and their tradeoffs are already complete. Much of the background information on scope, mandate etc. has already been discussed during the development of the CLMS. This will significantly decrease the amount of time necessary to design a defensible program.

Some follow-up materials that are invaluable to discussing the national boreal forest monitoring plan include:

1. Alberta Biodiversity Monitoring Strategy: Go to: http://www.fmf.ab.ca/pro.html → Foothills Model Forest Alberta Forest Biodiversity Monitoring Program . Overview → Monitoring Forest Biodiversity in Alberta → each of the Chapters as separate documents. Look first at Chapter 18, since that is the overall integration and summary chapter.

2. Matthew Carlson's MSc. Thesis (2001): "Cost effective sampling design for large-scale avian monitoring". His thesis is available through Fiona Schmiegelow's university web page, http://www.rr.ualberta.ca/Staff/fschmieg/index.html under the "Grad Student" link. A published paper on this topic appears at http://www.consecol.org/vol6/iss2/art11/manuscript.html

Proposed Next Steps

1. Circulate this paper to PIF technical committee for review and discussion. (November).
2. Circulate finalized document to meeting participants.
3. Form a team of 3-5 writers from across Canada to write a 2-4-page CWS boreal forest monitoring strategy. (complete by late March 2003).
4. Circulate the strategy document to Chiefs for review and comment.
5. Provide final strategy to CWS executive (sometime 2003).
6. Concurrently begin working on technical proposal for the monitoring program.
7. Concurrently complete analyses necessary to evaluate questions regarding BBS and migration monitoring raised in this discussion paper (ASAP?). (N.B. Erica Dunn has mostly or totally completed the relevant parts of these analyses as of Jan 2003).

Appendix 1: Whitehorse Meeting Agenda

8:30 Welcome, objectives and format of workshop, brief overview of current monitoring in Canadian boreal forest.
Craig Machtans, *Canadian Wildlife Service, Yellowknife*

8:50 Monitoring birds in a remote area: Yukon-Charley National Park, Alaska.
Debbie Nigro, *National Parks Service-Alaska*

9:10 Mini-BBS: A monitoring tool for roadless areas.
Colleen Handel, *U.S. Fish and Wildlife Service-Alaska*

9:30 Sampling Birds and Forest Biodiversity: Alberta Biodiversity Monitoring Strategy.
Jim Schieck, *Alberta Research Council*

9:50 The University of Alberta Remote Areas Project - Extreme Birding
Fiona Schmiegelow, *University of Alberta*

10:10 Coffee Break

10:30 Reflections on forest bird monitoring in Saskatchewan: from BBS to omnidirectional microphones.
Keith Hobson, *Canadian Wildlife Service-Saskatchewan*

10:50 The Ontario Breeding Bird Atlas.
Mike Cadman, *Canadian Wildlife Service-Ontario*

11:10 Monitoring Boreal Birds during Migration.
Jean Gauthier, *Canadian Wildlife Service-Quebec*

11:30 Canada's National Forest Inventory - An Interagency Partnership Project.
Mark Gillis, *Canadian Forest Service-Victoria*

12:00 Lunch

1:15 Brief morning lecture roundup: Some key points of design and experience from monitoring in the boreal forest.
Craig Machtans, *Canadian Wildlife Service, Yellowknife*

1:40 Round Table Discussion on several pre-determined points with the hope of consensus decisions on a number of items such as sampling methodology, frequency, coverage etc.

3:00 Coffee Break

3:20 Discussion continuation and Wrap-Up: Focus on Future.

4:30 Adjourn.

(Note: each presenter supplied a copy of their presentation for archive by Craig Machtans)

Appendix 2: Summary of Some Presentations

Workshop Introduction: Craig Machtans

The workshop purpose is to showcase current successful efforts at monitoring in the boreal forest. These successful efforts can be used as the foundation of a new national boreal forest monitoring plan. The other purpose of the workshop is to provide a forum for discussing issues related implementing a national monitoring plan. (Especially the more technical issues regarding objectives, design and implementation.) The workshop was initiated at the last CWS national monitoring working group meeting in spring 2002. The need for a national monitoring program has been identified by many different sources, and is articulated in the Canadian Landbird Monitoring Strategy. The old view of the boreal forest as an information black hole was raised, and contrasted with the need to change that paradigm by going "into the black hole" [boreal forest] to collect information. For the purposes of the national plan, the "boreal forest" is being defined as NABCI bird conservation regions 4, 6,7 and 8.

The ideal monitoring plan has complete coverage across the entire area of interest and samples all of the variables of interest. The drawback to such a plan is usually the cost and, secondarily, the logistics of implementing a sampling program in a remote area. The bare rudiments of the ideal plan are already in place: there are experienced people already monitoring portions of the boreal forest and there is a substantial and growing amount of baseline information. For existing information, there are BBS routes, migration-monitoring stations, MAPS stations, provincial atlases/checklists and research/monitoring studies. Examples of the type of information available include:

- BBS: there are already 336 routes available in the four boreal BCRs. However, only 209 of these have been run at least once in the last 20 years;
- The level of quality information from migration-monitoring stations is uncertain due to lack of detailed analyses;
- There are excellent provincial atlas programs that provide detailed range (and some abundance data) for birds in Yukon, BC, Alberta, Ontario, and Quebec. Manitoba and Saskatchewan have less advanced products. The NWT and Nunavut have a checklist program that can provide meaningful information easily.
- There are many research programs across boreal Canada that can provide background information. For example, over 6000 point counts were collated for a scientific summary of bird-habitat relationships in the western boreal forest. This is only a part of what is available across Canada.

Yukon-Charley: Debbie Nigro

In 1998, Yukon-Charley Rivers National Preserve received funding from the U. S. National Park Service Inventory and Monitoring Program to inventory avian species in the 2.5 million acre preserve. The goals for the subsequent inventory were to 1) design and implement an avian inventory plan in the preserve with methodology suitable for large parks and preserves that have minimal access and 2) develop a long-term monitoring protocol for birds in the preserve.

We used a stratified random sampling design to select sampling sites within the Preserve. Stratification was based on ecological subsections that were delineated at a scale of 1:250,000. Some ecological subsections were further delineated into detailed ecological units. Fourteen ecological subsections and 29 detailed ecological units were classified for the preserve. Our sampling units for the inventory were 9.66 km X 9.66 km township blocks created by overlaying the ecological unit map with a township and range grid. This grid created 139 blocks that contained some portion of the preserve. Only those blocks with at least 20% of their area contained within the preserve boundaries were eligible for selection (126 blocks). We then assigned each block an ecological subsection designator, based on which ecological subsection occurred at the center of the block. We then randomly selected blocks in proportion to the area of the preserve that each ecological section occupied. An additional block from each ecological subsection was randomly chosen each year as an alternate in case the selected block could not be accessed. Points were placed in each block in proportion to the area of each detailed ecological unit contained in each block.

Each year, four 2-person field crews and one swing person were trained extensively in identifying birds by sight and sound, estimating distances to birds, measuring habitats and cataloging point locations. Three weeks were devoted to training to assure that all field technicians were proficient at data collection and to minimize observer effects on data collection. We used variable circular plots with unlimited distance estimation to survey birds at sample points along transects. The distance between points along each transect and points between adjacent transects was ≥400 m in open habitats and ≥200 m in treed habitats. We targeted a minimum of 12 sampling points per transect, but as many points as possible were surveyed between 0230 h and 1000 h. At each sample point, we recorded distances to all birds seen and heard during an 8-minute count period (recorded as 2 intervals, 0-5 min. and 5-8 min.). Distances were recorded in 10-meter intervals out to 100 meters, in 25-meter intervals from 100 to 150 m, and as >150 m for distances beyond 150 m. Additionally, when traveling between points on a transect, we recorded all bird species not yet observed at the previous sampling points

We detected 12,266 birds of 85 species at 1415 count stations over the 2 years. An additional 30 species were detected while traveling between points. We detected 86% of the 134 bird species thought to breed in the preserve and calculated density estimates for 36 bird species; these 36 species represented 98% of all individuals detected during the inventory.

The cost for a startup year of a breeding bird inventory of this type amounted to approximately $121,450 ($6050 per block sampled, $173 per point sampled). This figure includes training, field, and data entry/proofing costs. It does not include salaries of permanent and term staff conducting project planning, ecological map preparation, personnel hiring, database development, data analysis, report writing, or conference presentations. Sixty percent of this inventory's cost was for salary and per diem expenses (for 9 people), with logistics accounting for 23% of the total and equipment purchase accounting for 16%. Logistical costs are dependent upon access means—fixed wing or boat would be cheaper than helicopter transport if such means were feasible; we determined that they were not viable options in the preserve. Equipment costs during the startup year will vary, depending on what resources are available and what needs to be purchased. Field staff numbers and grade levels as well as sampling intensity significantly impact the cost of this type of inventory. Reduction in the number of blocks sampled would reduce the cost of the inventory but may result in inadequate inventory coverage of the administrative unit being surveyed.

Mini-BBS: A monitoring tool for roadless areas. ***Colleen Handel***, USGS Alaska Science Center, 1011 E. Tudor Road, Anchorage, AK 99503, and Steve M. Matsuoka, U. S. Fish and Wildlife Service, 1011 E. Tudor Road, Anchorage, AK 99503

The existing road-based North American Breeding Bird Survey (BBS) provides some information on population trends of landbirds in Alaska but vast areas of the state remain inadequately sampled because of the absence of roads. Since 1992 Boreal Partners in Flight has been developing and testing methods for the Alaska Off-road Breeding Bird Survey, a proposed complementary program to monitor breeding landbird populations using a "mini-BBS" approach across roadless areas of the state. The primary objectives of the program are to (1) monitor long-term population trends; (2) determine the abundance of species by habitat within each ecoregion; and (3) map the distribution of landbird species across Alaska. The goal of the monitoring program is to have 90% power to detect a 50% change in population size for a given species over a 25-year period. Over the last decade, cooperators from many federal and state agencies, non-governmental organizations, Native corporations, and volunteer groups have participated in an experimental effort to refine methodology. The objective of the pilot program was to determine the sources and magnitude of variability in counts and to determine the sampling effort that would be required to meet the primary objectives. Seasonal and diurnal windows that minimize variability in detections have been identified for different ecoregions. Variability among sites was the greatest contributor to variation in counts. Simulation modeling showed that repeating surveys biennially would have almost as high a power to detect long-term trends as that of annual surveys because of interannual correlation among counts at a given site. Significant variation in detectability among observers and habitats would require that counts be adjusted so that densities could be compared across space and time. A target sample of 25 points per location was identified so that initial detection levels would be high enough to detect declines statistically.

A 10-km by 10-km sampling grid has been overlaid across the state of Alaska in a geographical information system. The initial sampling frame has been defined as federal resource lands in Alaska, excluding glaciers, ice-fields, and large lakes. These resource areas encompass about 678,000 km^2, or 45% of the state's land mass. An initial monitoring effort has been proposed to survey a randomly-offset grid of 25 points within each of 200 randomly selected sample blocks stratified by ecoregion and land management area. Each grid will be surveyed using 10-min point-transects (variable-circular plots) once per summer on a biennial basis (100 grids each year); habitat data will also be collected. A two-person crew could survey 6-8 grids per season during a three-week survey period with an initial two- to three-week training period. Access will be by helicopter, small plane, boat, or hike from nearest road. The estimated cost of field operations per grid for training, logistics, per diem, salary, and equipment is $3,000. This excludes costs for planning, coordination, data management and data analysis.

Data will be collected by agency staff and volunteers and will be archived in a central on-line relational database by the USGS Alaska Science Center. Preliminary statistical analyses will be conducted by the Alaska Science Center but data will be available publicly for further analysis. Data will be analyzed using distance-sampling methodology to adjust for differences among observers and habitats. Trend data from this program will be able to be analyzed jointly with trend data from the existing roadside BBS to test for differences between roadside and roadless areas and to increase power to detect statewide trends. The protocol has been designed so that additional grids can be surveyed for inventory or intensified monitoring within the existing sampling frame and to expand the frame to include other geographic areas as resources become available. Proposed products during the first 10 years include estimates of density and population size, measures of interannual variation in relation to weather, models of habitat use, and distribution maps. After 10 years, the first population trend estimates will be available. Long-term monitoring will enable analysis of change in distributional patterns of birds in relation to fire, forest disease, insect damage, urbanization, global climate change, and other landscape-level changes. The proposed level of effort would meet monitoring objectives for a minimum of 47 species, many at the ecoregional level. The proposed sampling design will be submitted for peer review in spring 2003 and initial grids will be field-tested in summer 2003.

Reflections on Monitoring from Saskatchewan: Keith Hobson

My presentation dealt with 2 theme areas; the retrospective use of existing BBS datasets to examine the effects of landscape change on breeding bird communities and the importance of controls in any monitoring program and the recommendation that large-scale monitoring for the boreal be best achieved through the use of recently developed omnidirectional microphones.

We examined North American Breeding Bird Survey (BBS) data for five routes affected by loss and fragmentation of local forest habitat and drainage or degradation of wetlands. We focused on the Brightsand, Saskatchewan (1979-1996) route since it once recorded the highest species richness for routes in Canada and has now dropped dramatically. We also examined other routes, Athabasca, Alberta (1972-1996), Two Hills, Alberta (1972-1996),Clouston, Saskatchewan (1973-1996), Tyndall, Manitoba (1971-1996), and one route located (as a control) in contiguous forest at Bird River, Manitoba (1976-1996), to determine how changes in land use influenced relative abundance and diversity of bird species. Over the 18-year history of the Brightsand route, species diversity declined from a maximum of 105 species in 1987 to 67 species in 1995. In addition, 43 species recorded regularly prior to 1990, have disappeared, and 13 other species showed significant negative population trends. This pattern was also seen in Athabasca and Tyndall, as population trends for eight species declined, as did four species on the Two Hills and Clouston routes between 1971 and 1996. Analysis of land cover data along the Brightsand BBS route indicated a 48 to 55% loss of forest cover from 1963 to 1994. Significant declines were not restricted to a particular guild of birds, as forest, grassland and wetland species all declined. In contrast, none of the species on the Bird River control route showed significant population declines. Habitat loss, due primarily to forest clearing and wetland drainage and modification for agriculture in the forest fringe region of the Canadian prairies, has contributed to the decline of species and disappearance of others on several BBS routes. This study emphasises that suitable control data integrated into a boreal monitoring program from the start will be essential to correct interpretations of long-term datasets.

Conventional acoustic surveys of avian communities require expert skills that are rare, particularly during the relatively short singing periods of most temperate North American species. We investigated the use of 2 newly developed omnidirectional microphones for field recordings of forest bird communities. Our study compared richness and abundance of species recorded by field experts and those inferred from simultaneous recordings later analyzed by the same observers. The acoustic recording technique worked well for bird communities associated with the southern boreal mixedwoods of central Saskatchewan and western Ontario. Similarity measures for both presence/absence and abundance data ranged from 83 to 97%. The acoustic recording technique, particularly when used in a stereo configuration, can be used to analyze species composition and relative abundance of forest bird communities. Moreover, this approach had numerous advantages including an archived record of point counts, the use of non-expert field staff to collect recordings, and the standardization of field data through time.

The Ontario Breeding Bird Atlas: Mike Cadman

Introduction

The Ontario Breeding Bird Atlas is a collaborative partnership of the Ontario Field Ornithologists (OFO), Federation of Ontario Naturalists (FON), Bird Studies Canada, Canadian Wildlife Service, and Ontario Ministry of Natural Resources. The Atlas is a volunteer-based project to determine the current distribution and relative abundance of the bird species breeding in Ontario. Data collection will take place over five years (2001-2005) with the Atlas being published in book form and on CD-ROM in 2008.

This second atlas is an enhanced, updated version of the first atlas project, which ran from 1981 through 1985, and produced the *Atlas of the Breeding Birds of Ontario* (Cadman et al 1987). The objectives of the second atlas are to:

- Repeat the coverage of the first atlas and provide detailed maps of each species' current distribution for comparison to the first atlas.
- Collect abundance data to allow contour mapping of the relative abundance of each species, and provide a baseline for comparison to future atlases.
- Record specific information on the location of breeding sites of rare species.
- Produce a published book and database available for research and conservation purposes.
- Get people out into the field where they can enjoy themselves birding and contribute to an important conservation project.

Methods

For the purposes of the Atlas, the province is divided into a grid using the Universal Transverse Mercator system. There are 1824 10-km squares in southern and central Ontario (north to about Temagami) and 105 100-km blocks throughout the north. Our goal is to cover every 10-km square in southern and central Ontario; five 10-km squares in every 100-km block in the boreal forest region; and two 10-km squares per 100-km block on the Hudson Bay Lowland. Volunteers cover 10-km squares, attempting to find breeding evidence for every species of bird nesting in each. Standard criteria are used to record data on standard data forms (Cadman et al 1987).

Data on relative abundance are collected using point counts. Point counts are of five-minute duration, and birds are recorded as > or < 100m. Counts are distributed 25 per square, mostly on roadsides, if roads are present. Roadside point counts are located randomly in each square. The number and location (by habitat) of off-road point counts in each square is based on how well the roadside habitats in that square represent the habitats as a whole in the square, as determined through a GIS analysis of classified Landsat Imagery. The location of off-road point counts within the assigned habitat is up to the participant.

Results

Over 48,000 hours, 15,000 point counts and 330,000 records have been contributed during the project's first two field seasons. Over 1000 breeding sites of rare species have been documented by atlas participants in the first two years of the project. Already, the project has revealed considerable change in the distribution of some species since the first atlas. The current data base from the second Atlas, as well as the full database from the first atlas, and species maps from both projects are available on the internet (www.birdsontario.org).

Covering the boreal forest

It appears as though the number of birders in Northern Ontario has decreased since the first atlas. Therefore, activities have been undertaken to enhance data collection in the north and to tie in with compatible research projects that might contribute to the Atlas. Of particular importance is a project of Bird Studies Canada entitled: *Evaluating the impact of forestry on bird communities in northern Ontario: towards an adaptive management paradigm*. This project will be undertaken during 2002 and 2003, and will provide about 6000 point counts and coverage of about 40 100-km blocks in the boreal region. The point count protocol is the same as for the atlas, but the points are distributed differently to answer questions about the effect of forest management on bird populations at the landscape level. These differences in sampling protocol will have to be considered when these data are combined with atlas data, analyzed and interpreted. Volunteer efforts are being arranged to complement those of the BSC project, and other similarly compatible projects, to help ensure that the Atlas achieves its goals in northern Ontario.

Breeding Bird Atlas projects have the potential to contribute considerably to any effort to monitor bird populations across the boreal forest:

- Spacing atlas projects at intervals of about 20 years (as is the widely accepted practice) provides a means of monitoring the distribution, status, and relative abundance of many species over the long term. As such, they complement projects designed to monitor population change in an on-going manner.
- It is too expensive and logistically impractical to maintain on-going, year-to-year, monitoring at the level provided by breeding bird atlas projects. However, by spacing projects on about a 20-year cycle, it is feasible to muster the financial and human resources required to successfully complete these huge undertakings.
- Atlas projects also monitor many species and areas not well monitored by other means.
- Atlas projects are compatible with these other on-going monitoring projects performed in the breeding season. Data from any such projects can be provided to the atlas, and

participants in these projects can provide atlas coverage in conjunction with their efforts on behalf of other projects. Efforts made to maximize the compatibility of other projects with the Atlas projects, and vice versa, will provide additional benefits to both.
- The grid system used by the Atlas provides a potential template or sampling structure for other monitoring projects.

References:
Cadman, M.D., P.F.J. Eagles and F.M. Helleiner. 1987. Atlas of the Breeding Birds of Ontario. University of Waterloo Press, Waterloo. 617 pp.

National Forest Inventory: Mark Gillis

Canada's National Forest Inventory (NFI) is an interagency partnership project. The current version of the NFI (commonly referred to as CanFI) is compiled about every five years by aggregating provincial and territorial forest management inventories. Basically, stand level data provided by the management agencies are harmonized to a national classification scheme, and then aggregated to the map-sheet, provincial/territorial, and national levels for storage, analysis, and reporting. Forest management inventories are the main source of information for the national inventory. Management agencies are continually updating and upgrading their forest inventories, so the age of the inventory and the inventory standards are constantly changing. As a result, the current NFI is a compilation of information of different vintages, collected to a number of different standards.

The current approach to national inventory is cost-effective in that it is based on existing data. The process is well established and accepted by the contributing agencies. The approach provides detailed information about the state of Canada's forests that is consistent with forest management information. The inventory also contains location specific information on the characteristics and quantity of the forest resource, providing mapping and spatial analysis capabilities. However, by design, some data in the current inventory could be up to 25-years old, and data standards could be variable. The current inventory lacks information on the nature and rate of changes to the resource, does not reflect the current state of the forests, and cannot be used as a satisfactory baseline to monitor change. The inventory also generally lacks information on non-timber vegetation attributes and is of unknown precision.
In support of increasing demands for additional information on forest resource attributes and policy development, national and international reporting (e.g., Kyoto Protocol, Criteria and Indicators of sustainable forest management processes (Canadian Council of Forest Ministers and Montreal Processes), FAO/ECE Forest Resource Assessments) a national forest inventory must provide:
- Data that are timely, reflecting the state of the resource at a defined time;
- Data types with uniform definitions and collected to the same quality standards nation-wide;
- Data that reflect consistent, and complete area coverage; and
- The ability to derive accurate trend assessments from successive inventories.

Provincial forest management inventories have been collected to varying standards, coverages and ages, and, as a result, do not meet these requirements. Because the current version of the NFI is based on provincial management inventories, it does not satisfy current and emerging requirements. In the fall of 1997 the Canadian Forest Inventory Committee (CFIC), a group of inventory professionals from federal, provincial and territorial governments, met to design a new format for the NFI. Instead of a periodic compilation of existing inventory information from across the country, the CFIC decided on a plot-based system of permanent observational units located on a national grid. The new plot-based NFI design will collect accurate and timely information about the extent and state of the Canada's land base, to establish a baseline of where the forest is and how it is changing over time.

Flexibility was a guiding principle in the development of the new plot-based NFI. Design details can be flexible as long as data consistency can be assured. The same attributes must be measured using the same standards in a statistically defensible manner at an acceptable level of precision. A core design, described in *A Plot-based National Forest Inventory Design For Canada* (Natural Resources Canada 1999), has been developedwith the following essential elements:

- A network of sampling points across Canada;
- Stratification of the sampling points by terrestrial ecozone, with varying intensity among the strata;
- Estimation of most attributes from remote sensing sources (photo plots) on a primary (large) sample;
- Estimation of species diversity, wood volumes and other desired data from a (small) ground-based sub-sample; and
- Estimation of changes from repeated measurements of all samples.

The new inventory will cover all of Canada. All potential sample locations reside on a countrywide 4 km x 4 km network. Each province and territory of Canada will decide on a 'best design' that will include samples located on a subset of the National Forest Inventory sample locations, on the 4 km x 4 km net, or samples selected by a different yet statistically valid design. To provide reliable area statistics, the objective is to survey a minimum of 1% of Canada's land mass. A 1% sample translates into a nominal design of 2 km x 2 km area plots located on a 20 km x 20 km network, resulting in approximately 20,000 sample plots for Canada. The 2 km x 2 km plots will be identified on conventional, mid-scale aerial photography, and will be delineated and interpreted in full according to land cover classes and other forest stand attributes. Satellite imagery will be used as a surrogate for aerial photography to provide attribute data for areas otherwise not covered by photo or ground plots (e.g., Canada's north). Attributes to be estimated from aerial photographs include area, land cover, forest type, age and volume of trees, disturbance activity, land use changes (reforestation, afforestation, and deforestation), mortality, access and human influence, and soil erosion. The flexibility of the design allows the network to be more intense to achieve regional objectives or less intense for non- forest, non- managed, or remote areas.

The new NFI design also calls for a minimum of 50 forested ground plots per ecozone, although no sampling is planned for the arctic ecozo nes. More intensive sampling will be required in some areas to meet regional objectives. The ground samples will in most cases be located at the centre point of the photo plot. Approximately 10 percent of the photo plot locations will be selected at random. Whenever a random location happens to fall on a permanently non-treed area, a substitute sample location is chosen, again at random; the initial locations maintain their status as NFI ground plots, and although no measurements are taken, the locations are retained in the analysis. Measurements of ground plots will be synchronized as well as possible with the interpretation of photo plots. Attributes and data collected in ground plots will complement and enhance the attributes and data from the photo plots. Additional attributes to be measured on the ground include species names of all plants in a plot (includes place of origin in case of exotics), mortality due to stresses (fire, insects, diseases), total above ground-biomass including coarse and fine woody debris, and current (5-year) volume growth based on periodic re- measurements. The ground plots will also contain information that is not normally collected in forest inventories such as litter and soil carbon. Attributes related to land use, ownership, protection status, access, human influence, conversion of forest lands, and the origin of exotic trees will be collected from management records, other data sources, and mapped information.

Remotely sensed data will also be used to enhance the new National Forest Inventory, to assess whether the location of plots are skewed in any fashion, to assess the extent of change and the need to revisit plots, and to provide other area-based parameters such as forest condition.
All NFI plots are permanent. Change will be estimated from repeated sampling of photo and ground plots. The intent is to completely sample the country within the next 5 years, covering 1/5 of the area each year in a statistically defensible manner. The first remeasurement will be spread over a 10-year period, covering 1/10 of the area each year in a statistically defensible manner. Each subsequent re- measurement will be spread over subsequent 10-year periods.
Since the CFIC meeting in 1997, considerable progress has been made on the development of the new NFI design. A number of documents have been produced including a design document (NRCan 1999) and planning documents examining the approaches, tasks and costs associated with the implementation of the plot-based NFI. Many jurisdictions have participated in pilot projects that led to refinements of data standards and procedures. Data standards have been defined, providing the basis for the construction of data models, databases and supporting data management tools. The information management systems will be finalized over the next two years with the development of the analysis and reporting functions.

The inventory is being implemented through memoranda of understanding between the federal government and the partner province or territory. The field implementation has begun in a number of jurisdictions, and agreements are being finalized with the expectation that the remaining jurisdictions will begin implementation next year.

Summary of Presentations: Craig Machtans

(This presentation was a point-form summary of some of the key points raised by presenters during the morning.)

The key points raised this morning (as interpreted by Craig) were:

1. Think big: Several presentations convincingly showed how it is possible to monitor vast, remote areas. This is exactly what we need to do for the entire boreal forest.
2. Collect data that is compatible with existing programs. Starting a new monitoring program means that results will not be useful for detecting change for many years. By collecting comparable data, inferences may be possible sooner, and inferences may be extended prior to the inception of the monitoring program.
3. Program design is critical: Careful thought must be applied to clearing defining objectives (which clearly leads to a particular sampling design), considering multiple uses of the data, and practicality of the program. Pre-survey ground-truthing of access, sample sites and other items is critical to the success of the field program.

4. Each location sampled should contain multiple sample points. Such a design minimizes shortcomings of the methodology such as single, short visits once per year or perhaps once every few years. It also allows integrating several sampling methods such as point counts and incidental observations into a standardized approach, greatly increasing the amount of useful data generated.
5. Use of control sites is critical if complete coverage is not achieved. Achieving complete coverage may occur eventually, and then there would be little need for a control area since all strata are being sampled. Areas that remain relatively undisturbed (e.g., Wood Buffalo and Prince Albert National Parks) must be monitored as benchmarks until such coverage is achieved.
6. Linking monitoring and management is critical. Data must be changed into information that must then be changed into knowledge. Knowledge can lead directly to management change. (Adaptive management). Data management and delivery to clients was often well thought out before any data were collected.
7. Any large program needs to consider the "C" words: collaboration and cooperation. Any successful program will have buy-in from all stakeholders.
8. There are innovative approaches to monitoring available, such as the use of omni-directional microphones. Such an approach has significant advantages (easier temporary staffing, permanently archived raw data, minimized observer bias, etc.), but also have some disadvantages (no visual observations). All approaches to implementing a program involve people who actually o the work, and it cannot be overemphasized how important "people care" can be to program success.